TEMPERATURE INVERSIONS IN THE ARCTIC ATMOSPHERE

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TEMPERATURE INVERSIONS AND THE ARCTIC CLIMATE

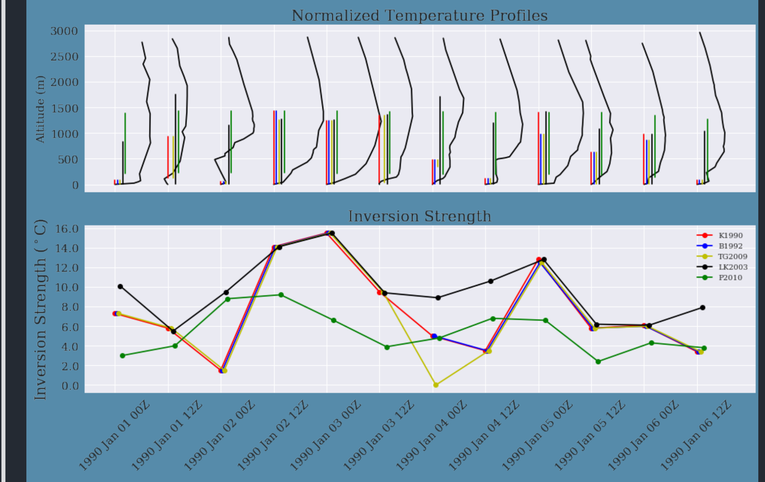
A temperature inversion is a layer of atmosphere where temperature increases with altitude. As warm air has a tendency to rise and cold air to sink, inversions represent extremely stable atmospheric conditions, inhibiting exchanges of heat, moisture, and pollutants.

Inversions are ubiquitous in the Arctic, appearing in up to 90% of observations at some locations. Inversions are characterized by their strength (difference in temperature from inversion top to base), depth, base height, and frequency of occurrence.

Properties of inversions affect many aspects of the climate, including sea ice dynamics, wind patterns, permafrost, pollution transport, visibility, cloud processes.

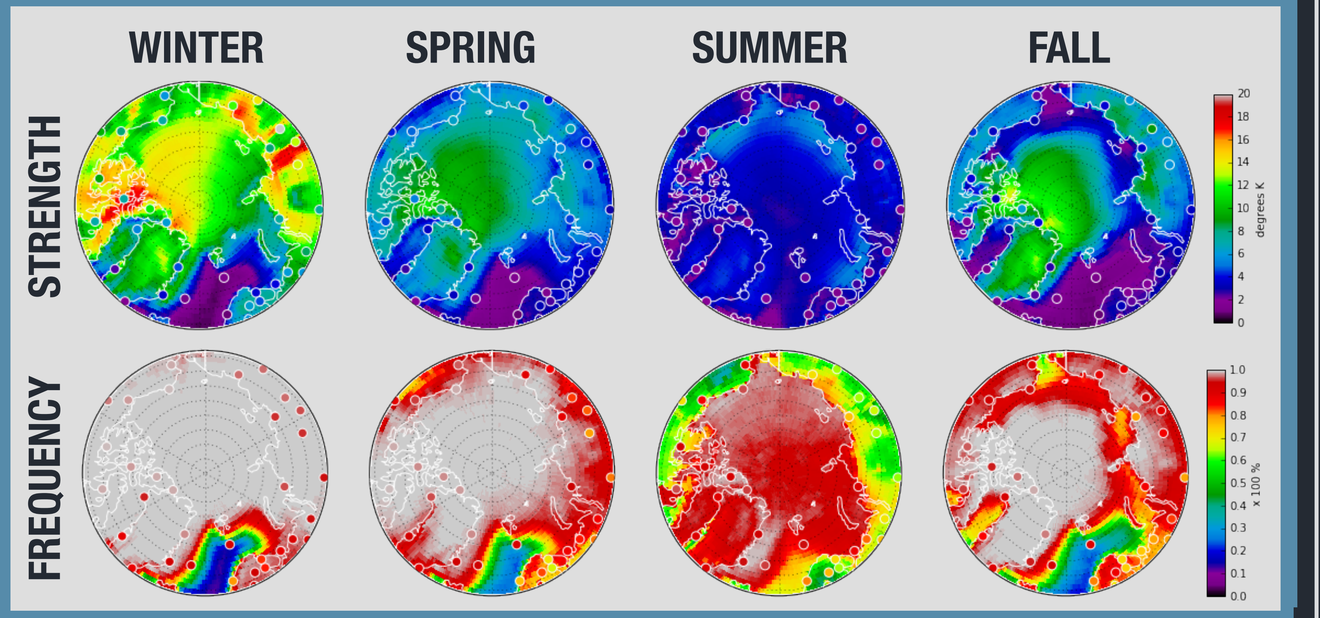
MEASURING INVERSIONS

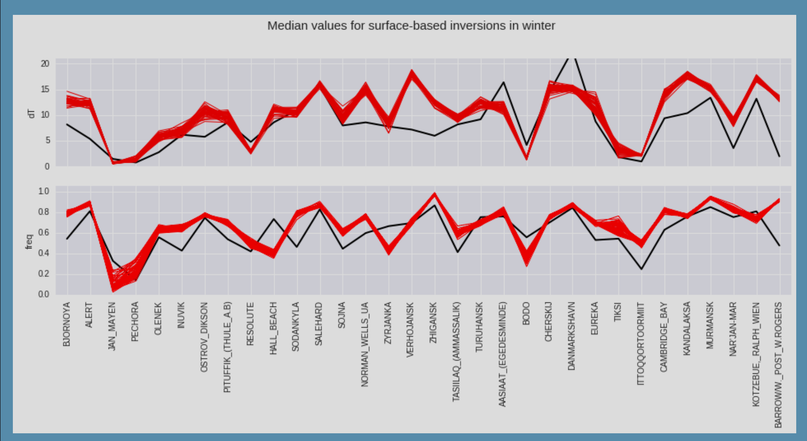
Methods for measuring inversion properties vary widely. The image below shows inversion layers detected by 5 different methods of identification, with the corresponding inversion strength below.



INVERSIONS IN THE CESM LARGE ENSEMBLE

The Community Earth System Model Large Ensemble (CESM LENS) is a publicly available set of 40 climate simulations designed to study internal climate variability and climate change. Using the algorithm from Kahl (1990), I computed temperature inversion statistics from 6-hourly output data covering the period 1990-2005 (approximately 7 TB of data).





QUESTIONS FOR FURTHER RESEARCH

What measure of inversion strength is “best”?
What controls the intermodal variation of inversion properties?
What changes to the inversion climatology should we expect in a warmer Arctic?
Are the errors in climate model representations of inversions due to clouds? Sea ice? Radiation transfer?

REFERENCES

Kay et al 2015 “The CESM Large Ensemble Project: A Community Resource for Studying Climate Change in the Presence of Internal Climate Variability” Bulletin of the American Meteorological Society, 96, 1333-1349

Zhang and Seidel 2011 “Climatological Characteristics of Arctic and Antarctic Surface-Based Inversion” Journal of Climate, 24, 19, 5167-5186

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